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ABSTRACT

This paper reports two studies which examined sequential dependence in the dyadic interaction between mother and infant. In the first study, brief videotaped behavioral samples were collected for 24 primiparous mother-infant (M - I) dyads to examine the degree of reciprocal contingency in M - I interactions. Two coders, using a computer interfaced event recorder, produced separate, continuous records for mother and infant of the sequence and duration of the binary states (present or absent) of facial gaze (FG) and vocalization (VOC) over 3 minutes of interaction. Among the results, mothers spent more time (92%) than infants (46%) in FG and similarly more time (41%) than infants (6%) in VOC. Mother initiated activity occurred more often than infant initiated activity. Infants showed a higher probability of terminating episodes of mutual FG and VOC. Outcomes of data shuffling and simulations of M - I interaction suggest that initially the M - I dyad may be a system that does not depend on the maintenance of a precise contingency between the activities of its components. Applying a continuous time Markov model to the continuous records, Study II (a larger study of 60 primiparous mothers with female infants at 12, 14 and 16 weeks of age) suggests that there are dependent components in the mothers' behavior. The infant seems to look and vocalize independently of the mother's behavior. Mothers apparently structure their behavior so that their infants can acquire basic rules of communication. (Author/RH)

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GAZE AND VOCALIZATION IN MOTHER-INFANT DYADS : CONVERSATION OR COINCIDENCE?

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Interest in interaction in infancy has gradually changed focus. Initially the major concern was with the development of the first psychological bonds. More recently interest has centred on the examination of the communicative structure and content of the interaction. This partly reflects the psycholinguists' desire to extend analyses into the preverbal period (Bates, Benigni, Bretherton, Camaioni, and Volterra, 1977) and the developmental psychologists' interest in the links between social and cognitive functioning (Schaffer, 1971). In both cases the bulk of the more recent research contains the implicit assumption that these early social exchanges are to some degree the prerequisites for later social, linguistic and intellectual development.

Two aspects of these early interactions between mother and infant have recently assumed particular importance. The first is the temporal patterning of interactive behaviour in infancy or the sequence and flow of the behaviours of mother and infant. Several authors have referred to the "conversational" structure of these prelinguistic exchanges (e.g. Brazelton, Koslowski & Main, 1974; Freedle & Lewis, 1977; Newson, 1977; Schaffer, 1974; Snow, 1977; Trevarthen, 1977). Bateson (1975) concludes that "...the vocal exchanges of preverbal infants and their mothers can be treated as proto-conversations" (p.111).

The second, related, aspect concerns the conflicting interpretations that have been given of the infant's part in such interactions. To give two examples, Trevarthen (1977) has argued that it is the infant who *calls the tune* in interaction with the mother and that the appearance of this ability so early in life suggests an innate pre-adaptive basis for intentional communication.

Schaffer (1974) accepts the general proposition that the infant is the initiator of many behavioural sequences but ascribes the dialogue-like character of the interaction to the *mother's skill* in matching her infant's pace and filling in the gaps; a skill that creates the *impression* of conversation.

But to what extent are the interactions between mothers and infants conversational? We take the term conversational to imply a contingent, reciprocal interchange in which the behaviour of each partner influences the subsequent behaviour of the other. Such a definition seems implicit in Newson's (1977) description of a conversational sequence as "an alternating chain of communication gestures" with "the timing of the gesture and its contextual significance" viewed as "more important than the precise movements of which it is made up" (p.52). This is similar to Fogel's (1977) description of interaction in terms of the temporal distribution of runs and time outs, and Stern's notions of the phrasing and pausing typical of both the kinesic and the vocal aspects of the interactions of mothers and infants (Stern, Beebe, Jaffe & Bennett, 1977).

The question then is whether the behaviours of the mother and her infant are reciprocally linked, and by implication contingently linked, or whether the temporal patterning reflects the concurrence of the events of each actor without immediate causal connection. In other words, the proposition that the infant responds contingently may not be a necessary element in a theory of the development of communication in mother-infant interactions. Two studies are reported which have examined the sequential dependence in the dyadic interaction between mother and infant.

STUDY 1

The first study used a number of simple empirical methods which made a minimum of assumptions about the nature of the sequential process underlying the dyadic visual and vocal interactions.

Method

Data Base

To examine the degree of reciprocal contingency in mother-infant (M-I) interactions, brief videotaped behavioural samples were collected for 24 primiparous M-I dyads (mean infant age = 15.4 weeks; SD = 6.9 weeks) observed in a New South Wales Infant Health Centre. The procedure and observational arrangements were similar to those used by Trevarthen (1977): The mother and infant sat facing each other and a mirror, positioned to the right of the infant enabled filming of both faces in juxtaposition, using a single camera. The camera was approximately 3 metres from the infant's face, and focussed over the mother's left shoulder. Following Trevarthen's (1977) procedure, the mothers were asked to chat and play with their baby just as they would at home. Three minutes of such behaviour was then videotaped.

Two coders, using a computer interfaced event recorder, produced separate, continuous records for M and I, of the sequence and duration of the binary states (present or absent) of facial gaze (FG) and vocalization (VOC) throughout the interaction. A summary was then compiled of the four mutually exclusive dyadic states

which result from the combination of the M and I binary records (see Table 1). The summary included measures of the occurrence and mean duration of each state, as well as a matrix of the state transitional probabilities.

Table 1

Definition of Dyadic States Derived from the Combination of Mother and Infant Binary States

Mother State	Infant State	Dyadic State[a]	
Off	Off	Quiescent	(QS)
Off	On	Infant Alone	(IS)
On	Off	Mother Alone	(MS)
On	On	Coacting	(CS)

[a] After Bakeman and Brown (1977)

Results

The Observed Processes for Facial Gaze and Vocalization

The descriptive data from the dyadic state summaries provided evidence of the asymmetrical contributions of M and I to the interaction: M spent more time (92%) in FG than I (46%) and similarly more time (41%) in VOC than I (6%). There was a higher probability of the M initiating activity (FG = .84, VOC = .89). On the other hand, the I showed a higher probability of terminating episodes of mutual FG (.80) and VOC (.77). Mutual FG had a high probability of occurrence following either a mother FG state (.77) or an infant FG state (.70). However, mutual VOC showed low probabilities of occurrence following both M (.12) and I (.18) VOC states.

It must be recognized, however, that the dyadic summaries, and in particular the transitional probability matrices, do not provide evidence of reciprocal contingency per se. They could equally be interpreted as coincidental, merely reflecting the concurrence of events without causal connection.

Randomly Shuffling the Original Records

One way of approaching this problem is to manipulate the responding of one of the partners in the dyad. Trevarthen (1977) has attempted this by asking the mother to voluntarily "freeze" her face and, presumably, break the pattern of contingency in the dyadic communication. But as Trevarthen admits, this is a difficult state for some mothers to achieve. In another attempt, a student of Trevarthen swapped the mother's face for the image of another adult, by changing the lighting on either side of a partially reflecting window. While both techniques resulted in qualitatively changed infant responding, it is difficult to decide whether such manipulations establish the existence of *communicative* contingency or merely reflect the infant's response to gross changes in the perceptual field.

A relatively simple method, which avoided the inherent problems of *in vivo* attempts, was used to examine the degree of reciprocal contingency in the patterns of dyadic facial gaze and vocalization. It was argued that if the original binary records of mother and infant were contingently linked, then randomly permuting (shuffling) one of the records should result in a significantly different set of dyadic summary data.

The infant binary records of ten dyads for FG and six dyads for VOC were shuffled ten times and the resulting dyadic summaries averaged. When correlated with the summaries from the original records these showed little change (see Tables 2, 3 and 4). Of the 32 FG and VOC summary measures from the shuffled records, 25 correlated significantly with the original records, providing some evidence of the independence of the behaviours of M and I.

Simulation of Independent and Dependent Dyadic Processes

An examination of the distributions of the binary states for mother and infant produced some evidence of a negative exponential distribution of the durations of stay in each state. A model was developed in which the mean "on" and "off" times of mother and infant could be used to simulate the mother and infant binary records, independently. In other words, binary records were produced which had similar underlying distributions to the original, observed records but which by design lacked any contingency.

Simulations were carried out using the distributional parameters from three FG and three VOC records. The summaries produced closely approximated those from the original observed data, and when randomly shuffled, once again revealed essentially unaltered results. For both FG and VOC the transitional probabilities from the simulated FG records remained unperturbed by the random shuffling (see Figures 1 and 2). The patterns of exits from states and state durations also reasonably matched the original results (see Tables 5 and 6). In sum, the results of the simulation suggest that it provides a reasonable approximation to the original, observed data.

Table 2

Mean Number of Exits from States, and Mean Durations of Stays in Each State of Mother and Infant Facial Gaze, with Correlation Coefficients, for the Original and the Shuffled Records of Ten Dyads

State	Dyadic Records		
	Original	Shuffled	r
Mean Number of Exits from State			
QS	6.2 (3.8) *	5.2 (2.9)	.90[a]
IS	4.5 (3.7)	4.8 (4.3)	.93[a]
MS	18.4 (8.1)	18.4 (8.0)	.93[a]
CS	16.8 (6.7)	17.4 (8.1)	.99[b]
Mean Duration of Stay in State (Sec.)			
QS	1.13 (.74)	1.01 (.59)	.98[b]
IS	.54 (.30)	.76 (.32)	.47
MS	5.57 (3.11)	5.40 (2.84)	.96[b]
CS	4.44 (1.64)	4.30 (1.87)	.93[a]

* (Standard Deviations)

[a] $p<.0005$

[b] $p<.0001$

Table 3

Mean Number of Exits from States, and Mean Durations of Stays in Each State of Mother and Infant Vocalization, with Correlation Coefficients, for the Original and the Shuffled Records of Six Dyads

State	Dyadic Records		
	Original	Shuffled	r
	Mean Number of Exits from State		
QS	92.7 (6.9) *	93.7 (1.6)	.96[c]
IS	11.8 (6.7)	12.0 (1.6)	.99[e]
MS	94.7 (12.2)	96.3 (3.4)	.99[e]
CS	14.7 (10.7)	14.4 (1.6)	.98[d]
	Mean Duration of Stay in State (Sec.)		
QS	.87 (.17)	.87 (.02)	.99[e]
IS	.22 (.07)	.20 (.03)	.81[a]
MS	1.00 (.10)	.99 (.07)	.94[b]
CS	.21 (.08)	.22 (.03)	-.21

* (Standard Deviations)

[a] $p<.05$

[b] $p<.01$

[c] $p<.005$

[d] $p<.001$

[e] $p<.0005$

Table 4

Correlation Coefficients for the State Transitional Probabilities of the Original and Shuffled Facial Gaze and Vocalization Records of Mother-Infant Dyads

State Transition	Facial Gaze r^{*}	Vocalization r^{**}
QS → IS	.20	.95 [c]
QS → MS	.31	.95 [c]
IS → QS	.47	-.01
IS → CS	.80 [b]	.04
MS → QS	.74 [a]	.94 [b]
MS → CS	.77 [b]	.94 [b]
CS → IS	.89 [d]	.89 [a]
CS → MS	.90 [e]	.89 [a]

* n = 10 [a] $p<.02$ [c] $p<.005$ [e] $p<.0005$

** n = 6 [b] $p<.01$ [d] $p<.001$

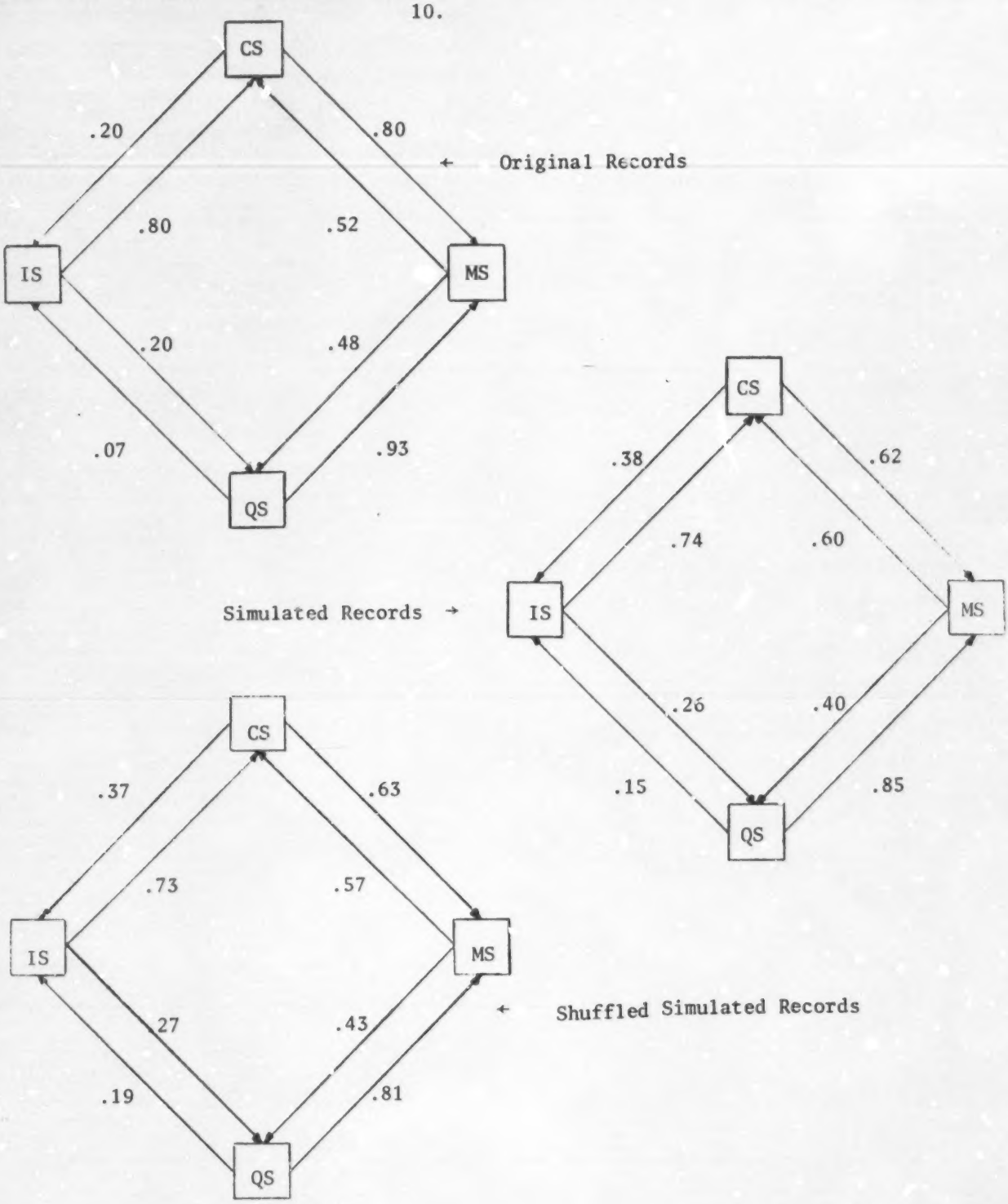


Figure 1

Mean State Transitional Probabilities for Dyadic Facial Gaze, from the Original, Simulated and Shuffled Simulated Records of Three Dyads

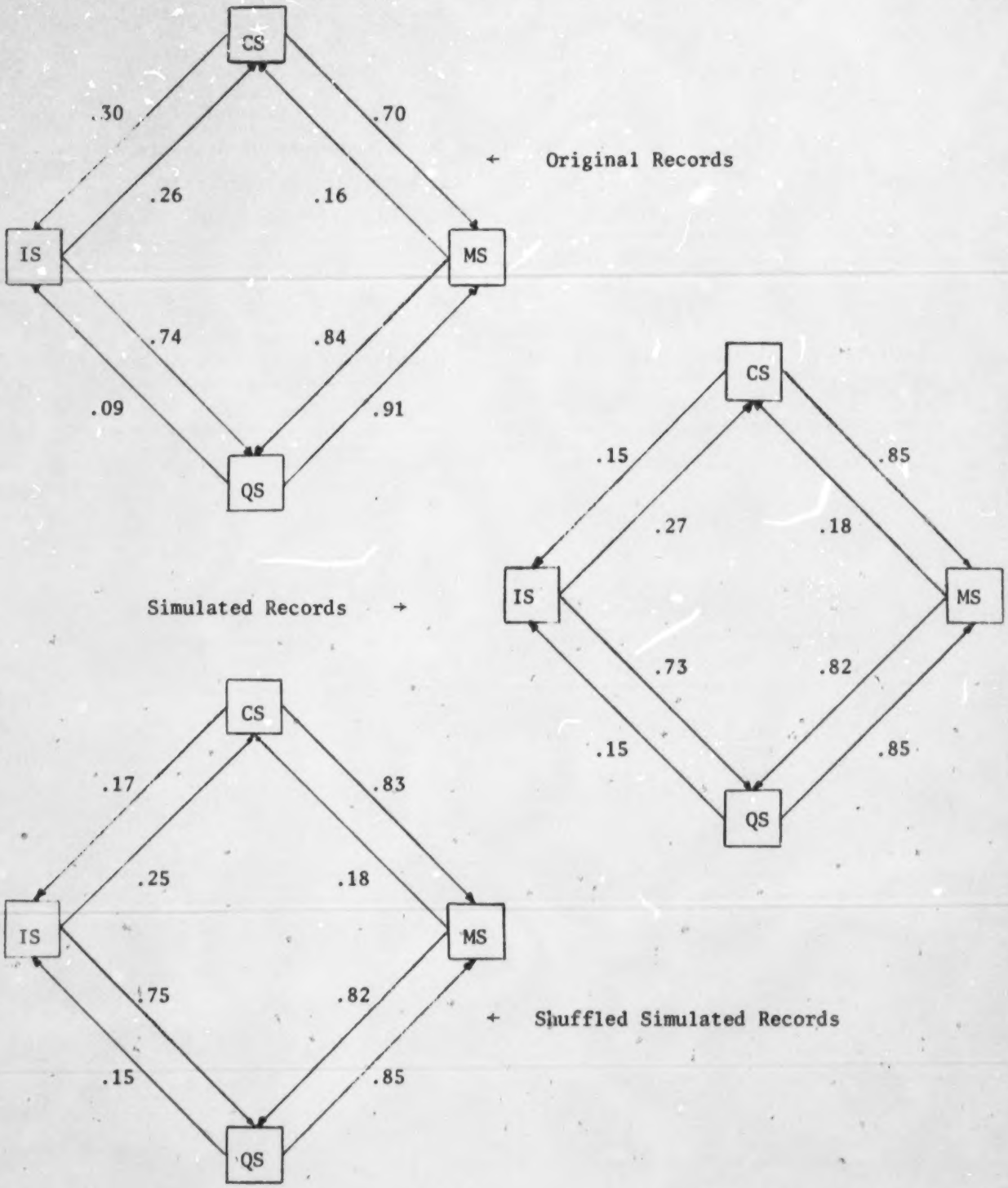


Figure 2

Mean State Transitional Probabilities for Mother and Infant Vocalization, from the Original, Simulated and Shuffled Simulated Records of Three Dyads

Table 5.

Mean Numbers of Exits from States, and Mean Durations of Stays in Each State of Mother and Infant Facial Gaze for the Original, Simulated and Shuffled Simulated Records of Three Dyads

State	Dyadic Records		
	Original	Simulated	Shuffled
	Mean Number of Exits from State		
QS	12.7	11.3	12.0
IS	5.3	9.7	10.0
MS	25.0	21.7	21.3
CS	18.3	19.7	19.0
	Mean Duration of Stay in State (Sec.)		
QS	1.32	1.11	0.97
IS	0.55	0.87	0.84
MS	2.68	3.21	3.19
CS	3.05	2.66	2.86

Table 6

Mean Numbers of Exits from States, and Mean Durations of Stays in Each State of Mother and Infant Vocalization for the Original, Simulated and Shuffled Simulated Records of Three Dyads

State	Dyadic Records		
	Original	Simulated	Shuffled
	Mean Number of Exits from State		
QS	95.3	97.3	98.7
IS	12.0	19.7	19.0
MS	102.0	103.0	104.7
CS	20.0	26.0	25.0
	Mean Duration of Stay in State (Sec.)		
QS	0.78	0.78	0.79
IS	0.23	0.21	0.20
MS	1.02	1.00	0.98
CS	0.21	0.23	0.24

The independent simulation provides further evidence of the weakness of any contingency that may exist in the original records. But is stability after shuffling the record sufficient demonstration of the lack of dependence between the mother and infant records?

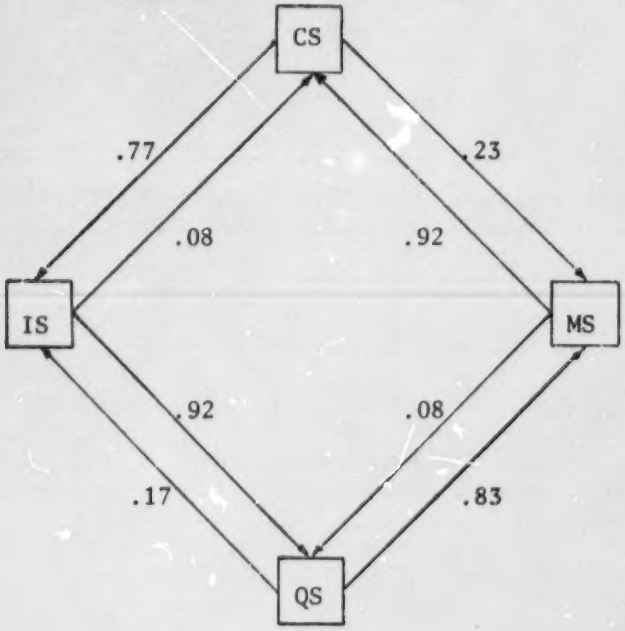
To address this question a strongly dependent process was simulated in which the infant's periods "on" and "off" are conditional upon the state of the mother's binary process. For example, if the mother's distribution of the "on" and "off" states is of negative exponential form, with mean durations of 5 seconds, then when the mother is "off", her infant will be "off" for 10 seconds but "on" for only 1 second. On the other hand, if the mother is "on" her infant will now be either "off" for 1 second or "on" for 10 seconds.

Examination of Figure 3 reveals that the behaviour of the transitional probability matrix of this dependent process when shuffled is quite different to that of the original records or the independent simulations. In this case the change in the transitional probabilities is quite dramatic, reflecting the perturbation of the contingent relationship between the hypothetical mother-infant process. Similarly, the state exits and durations also changed as a result of shuffling (see Table 7).

STUDY 2

The outcomes of the shuffling and simulations conducted in Study 1 suggest that initially the mother-infant dyad may be a system that does not depend on the maintenance of a precise contingency between the activity of its components. Certainly, firm evidence

Simulated Dependent Process



Shuffled Simulated Dependent Process

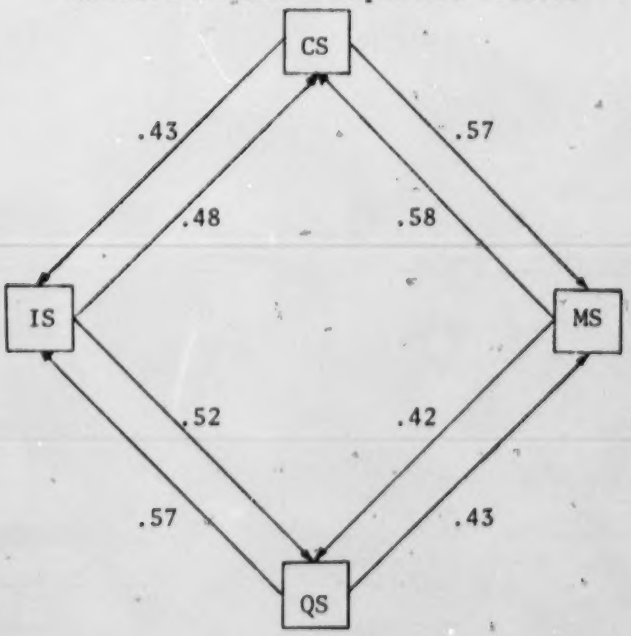


Figure 3

State Transitional Probabilities from the Simulated Dependent Process Record and the Shuffled Simulated Dependent Process

Table 7

Numbers of Exits from States, and Durations of Stays in Each State for the Simulated and Shuffled Dependent Process

State	Dyadic Records	
	Simulated	Shuffled (Mean of Ten)
	Number of Exits from State	
QS	24.0	23.5
IS	24.0	24.9
MS	26.0	25.1
CS	26.0	26.4
	Duration of Stay in State (Sec.)	
QS	2.93	2.00
IS	0.88	1.85
MS	1.02	2.04
CS	2.95	2.00

of contingency in the FG and VOC interactions observed did not emerge.

However, the techniques used in Study 1 could not provide a fine-grained appraisal of whether the mother and infant processes are completely independent. The mother's persistent vocalization and facial gaze, seemingly irrespective of her infant's behaviour, may have swamped any episodes of contingent responding by the infant. A more precise procedure is required for estimating the specific effects of the onset and offset of one partner's behaviour upon the other. Study 2 attempted to adopt such a procedure and apply it to the FG and VOC records of mother-infant dyads.

Method and Results

Data Base

Study 1 had involved dyads with infants of considerably varying age. For Study 2 data from a larger project provided FG and VOC records for dyads with female infants at 12, 14 and 16 weeks of age (15 at each age). Only dyads with primiparous mothers were included. The procedures for collecting and coding the videotapes were identical to the first study.

The coded records for FG and VOC in Study 2 showed an asymmetry similar to that observed in the first study, with the mean percentages of FG and VOC again indicating the mother's domination of the interaction (see Table 8). This asymmetry is also reflected in the mean percentages of time spent in each FG and VOC state (see Table 9). For FG very little time is spent in the IS; the coacting state being

Table 8

Mean Percentages of Facial Gaze and Vocalization for Mothers and Infants Aged 12, 14 and 16 Weeks

Dyadic Member	Infant Age in Weeks		
	12	14	16
	Facial Gaze (%)		
Mother	96.5	96.7	96.7
Infant	48.9	43.9	28.9
	Vocalization (%)		
Mother	43.9	40.6	36.5
Infant	6.1	5.2	6.8

Table 9

Mean Percentage of Total Time Spent in Each Facial Gaze and Vocalization State by Dyads with Infants Aged 12, 14 and 16 Weeks

State	Infant Age in Weeks		
	12	14	16
Facial Gaze			
QS	2.4	2.7	2.7
IS	1.2	0.6	0.5
MS	48.7	53.6	68.4
CS	47.7	43.1	28.4
Vocalization			
QS	52.5	56.2	58.8
IS	3.6	3.3	4.6
MS	41.5	38.5	34.4
CS	2.4	2.0	2.2

the one in which almost all infant FG occurs. The low overall level of infant VOC is also mirrored by the very small percentages of time spent in the IS and CS.

Figures 4 and 5 present the transitional probability matrices for FG and VOC and these again show almost identical asymmetry to the matrices for Study 1. Again it can be concluded that the interaction has a very different basic structure to adult conversation.

Adoption of a Markov Model

Study 1 had tried to examine the question of dependence by using techniques which made minimal assumptions about the form of the underlying distribution. However, such a strategy, while acceptable for a preliminary investigation of the four state process and its dependence, cannot invoke the powers of estimation and prediction that appropriate mathematical models provide. As Study 1 had shown the distributions of the mother and infant processes reasonably approximated a negative exponential, the distribution underlying a Markov process.

A continuous time Markov model was adopted; primarily because continuous records were available and it was felt unnecessary to impose a discrete time structure on such data. In addition, the problems encountered in selecting a sampling interval were also avoided.

A wide range of sampling intervals have been reported in the literature (e.g. 300 msec. for Jaffe & Feldstein, 1970; 600 msec. for Stern, 1974; 1 sec. for Anderson, Vietze & Dockecki, 1977; 5 sec. for Bakeman & Brown, 1977; 10 sec. for Lewis & Freedle, 1973).

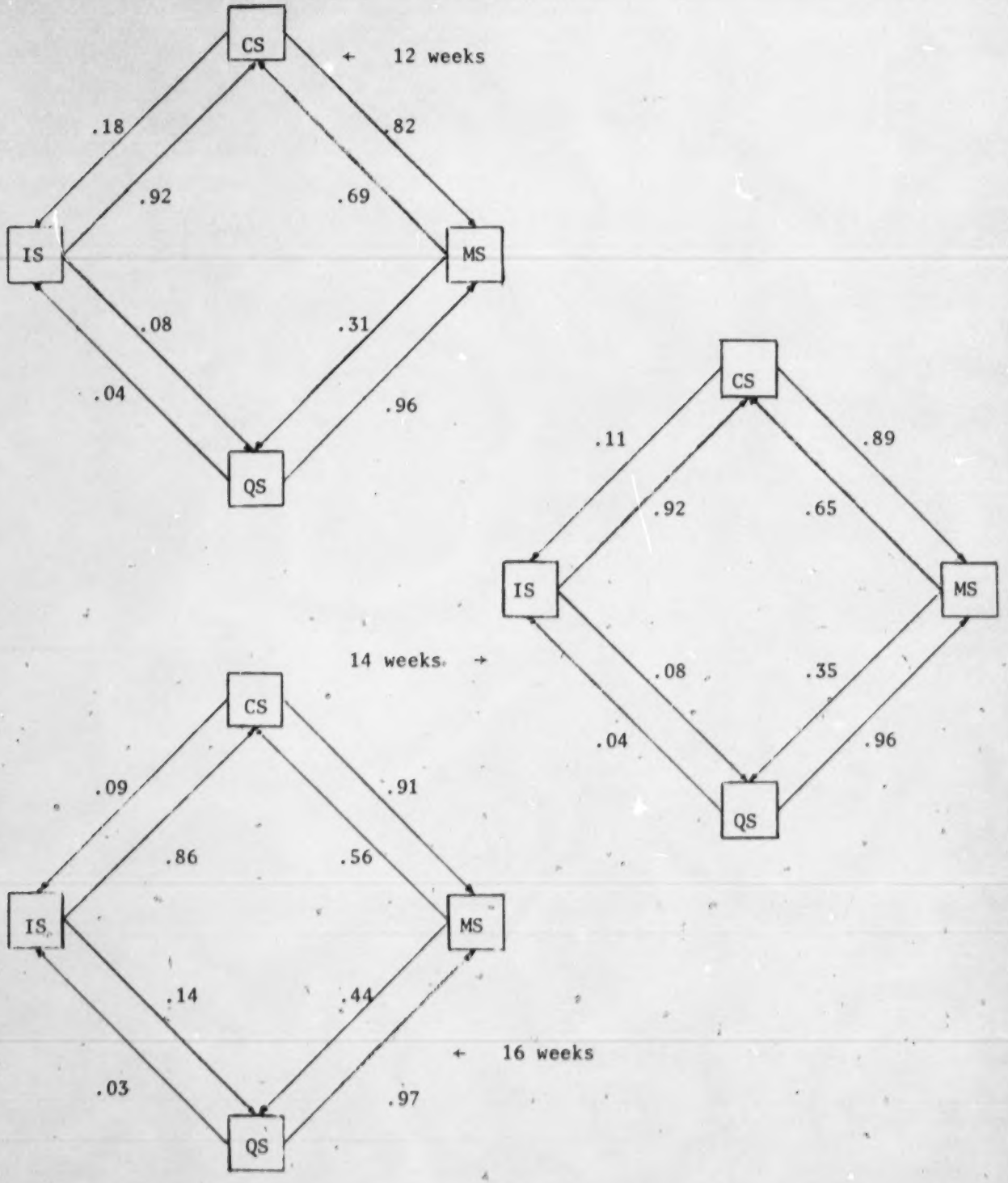


Figure 4

Mean State Transitional Probabilities for Dyadic Facial Gaze at Each Infant Age in Study 2

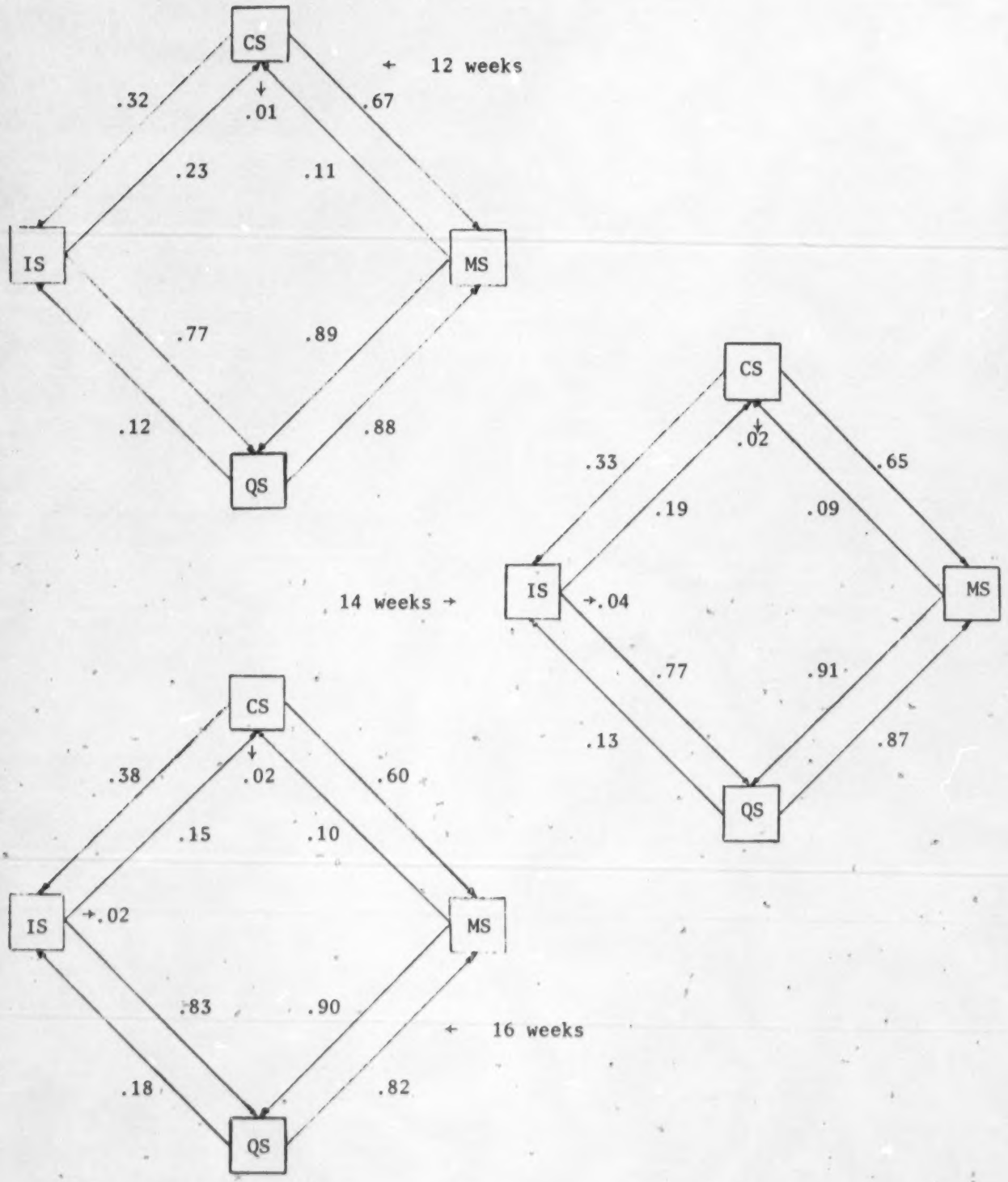


Figure 5

Mean State Transitional Probabilities for Dyadic Vocalization at Each Infant Age in Study 2

There is clearly a need for careful consideration of the effects of sampling time upon the coded records of the sequential process. The changes with increasing sampling time can be precisely computed for a Markov process if a point sampling technique is involved. Preliminary calculations suggest that the VOC process begins to approach its limit (converges) at sampling intervals of the order of 1 sec. Further, the data indicate that the common practice of interval sampling (particularly when of the order of 1 to 10 sec) provides a poor estimate of states having a short average duration.

For Study 2 the matrix of intensities of transitions (A) was used to examine the dependence present in the underlying four state Markov process. The intensities are a more basic set of parameters upon which the transitional probability matrix (P(t)) depends. P(t) is related to A by the following formula[1]:

$$P(t) = e^{At}$$

Thomas and Martin (1976) have recently presented an elegant model for the analysis of the self-regulatory and interactive effects in discrete state processes. To examine the effect of the behaviour of each dyad member upon the other, Thomas and Martin amplify a suggestion by Stern (1974) that the differences between selected pairs of transitional probabilities provides a test of specific reciprocal influences. In the present study the technique was applied to the intensities (λ_{ij}) and the following null hypotheses were tested:

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[1] *The second author (T.E.) is currently preparing a detailed description of the continuous time four state model including discussion of the advantages of using the intensities as the basic parameter set for describing continuous time Markov processes.*

1) $\lambda_{13} = \lambda_{24}$ (M activates independent of I)[1]

2) $\lambda_{31} = \lambda_{43}$ (M de-activates independent of I)

3) $\lambda_{12} = \lambda_{34}$ (I activates independent of M)

4) $\lambda_{21} = \lambda_{43}$ (I de-activates independent of M)

The results for FG and VOC are listed in Table 10.

For FG the M de-activation comparison was the only one to show a significant difference across all three age groups. Simply put, mothers were more likely to terminate FG when their infant was not looking. However, mother activation did not depend on the infant's state. Similarly, with the exception of the 12 week group, I activation appeared independent of the mother's state. In every age group I de-activation was also independent of the mother's behaviour.

The VOC analyses failed to show any evidence of dependence for either I activation or de-activation, and M de-activation seemed independent of her infant's vocal state. However, for all three groups, M activation was dependent upon the infant's behaviour, with the mother more likely to vocalize when her infant was silent.

Discussion

The results of Study 2 suggest that there are dependent components in the dyadic interaction, but only the mother's behaviour shows any consistent evidence of the effect of such

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[1] *The subscripts indicate state transitions. The states have been numbered 1 (QS), 2 (IS), 3 (MS) and 4 (CS).*

Table 10

Comparison by t Test of Pairs of Transitions Indicating Contingent Activation and De-activation of Mother and Infant Facial Gaze and Vocalization

Effect	Comparison	Infant Age (in weeks) 12	14	16
		Facial Gaze		
Activation				
Mother	QS→MS:IS→CS	0.50	-0.80	-1.65
n =		(12)	(10)	(6)
Infant	QS→IS:MS→CS	-2.50 *	-1.48	-1.49
n =		(15)	(14)	(14)
De-activation				
Mother	MS→QS:CS→IS	4.66 ***	3.46 **	2.99 *
n =		(15)	(15)	(14)
Infant	IS→QS:CS→MS	-0.24	0.48	0.33
n =		(12)	(11)	(7)
		Vocalization		
Activation				
Mother	QS→MS:IS→CS	2.88 *	2.26 *	4.04 **
n =		(15)	(15)	(15)
Infant	QS→IS:MS→CS	-0.78	0.67	1.71
		(15)	(15)	(15)
De-activation				
Mother	MS→QS:CS→IS	-1.01	-0.24	-0.69
n =		(15)	(24)	(14)
Infant	IS→QS:CS→MS	-0.38	0.25	0.15
n =		(15)	(15)	(14)

* $p<.05$ ** $p<.01$ *** $p<.001$

dependence. The infant seems to look and vocalize independently of the mother's behaviour. These findings are consonant with the results Thomas and Martin (1976) report for analyses of data on mother-infant vocalization (from Lewis & Lee-Painter, 1974) and smiling (from the Stanford Longitudinal Study). They suggest that while both the self regulatory and interactive components determine the mother's behaviour, the infant's behaviour is "determined by the self-regulatory component alone".

The results emerging from a number of projects suggest that for behaviours like gaze and vocalization there is sufficient evidence to reject the hypothesis that the interactions are completely coincidental. However, at the same time there is not enough evidence of reciprocal contingency to say that they are conversational, in any strongly contingent sense. Rather, the dependence of the mother's vocal activation indicates that she at least *regards* the interaction as a dialogue, and acts as if her infant were a reciprocating, conversational partner. As Snow (1977) has concluded, the three month old's mother *imposes* the rules of conversation upon the interaction; rules of which her infant is yet unaware.

The pattern of dependence for facial gaze similarly provides an interesting insight into the structure of mother-infant interaction. Given that for over 90 percent of the time the mother is looking at her infant, it is significant that she has a higher likelihood of looking away when her infant is *not looking* at her. Her aim is clearly to maximize mutual facial gaze (Hayes, 1978), although she must look away from her infant at times. Whether these gaze changes are determined by the interactive or self-regulatory components is

not clear, but their timing is clearly dependent upon the state of the infant.

For both FG and VOC the interactions are asymmetrical; a fact which suggests that the gross adaptation of the mother's interactive behaviour when with her infant, provides the redundancy necessary to ensure the continuance of the interaction. But even more importantly the interaction continues in a form which provides the infant with important information about the structure of visual and vocal communication (Anderson, 1977; Hayes, 1978). Mutual facial gaze and non-overlapping vocalization have fundamental significance for human communication, and the mother seems determined to structure her interactive behaviour in a way which maximizes the opportunities for her infant to acquire these basic communicational rules. However, this does not explain how and when the infant begins to respond reciprocally.

One of the disabling impediments to the progress of research on early interaction and the development of communication seems to be the selection of the appropriate level of analysis. Micro-analysis of single behaviours is almost certainly inadequate. And models based on simple aggregates of single behaviours may not be any better.

Science is always limited both by the conceptual models currently available, and the methodologies available to operationalize these models. Discrete state models of interaction were elegant conceptually and, with the rapid development of microprocessor event recorders, operationally attractive. Similarly, the transitional probability matrices they generated promised a simple

summarization of the dynamics of interaction. However, taken *at face value*, transitional probabilities are equivocal on issues of reciprocity: Taken from inappropriately sampled records they may be completely erroneous! The models provided by Thomas and Martin (1976) underscore the need for complementary micro and macro level analyses, but such analyses must be applied with better regard for the situational influences which determine the structure of particular interactional episodes. Aggregating across situations such as play, feeding and bathing (Anderson et al, 1977) or selecting micro segments of film (Trevarthen, 1977) may equally provide unrepresentative summarizations of the situationally changing structure of mother-infant interactions. Again the perennial problems of selecting the appropriate levels of measurement and explanation continue to raise their hoary heads.

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